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Evolution of Internet of Things (IoT)

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Abstract: IoT collaborates of three major domains of technology namely i.e Cloud, IOT (Internet of Things) and Data Mining. The title 'IOT' itself is indicative of the fact that this project imparts intelligence to the 'things' in IOT which is a concept that envisions all objects around us as a part of the internet resulting in ubiquitous computing. This proposition is attained by proposing a cloud based system wherein smart sensors are embedded on the devices which will continuously monitor their operational status and detecting any fault or failure in the device functioning, it will immediately find an appropriate solution by applying Naive Bayes data mining algorithm on the database inclusive of similar previous instances of malfunctioning and by that resolving the issue without any human intervention.

Keywords- Internet of Things (IoT), Cloud Computing, Data Mining, Smart Sensors, Naive Bayes Algorithm

I. INTRODUCTION

An instance of exemplary projecting and merging of two worlds i.e Physical World with the Digital World is the Internet of Things (IoT). IoT is simply a event of an augmented world which aims at achieving ubiquitous computing. As expressed in the Black Swan Seminar Series on IOT, Internet of Things apprehend the notion of "Connect Anywhere, Anytime with Anything" [1]. The term Internet of Things came into existence in 1999 by Kevin Ashton. IoT which was just an unachievable vision then, today is one of the technological trend and rigorous work on its effective implementation is in progress.

Implementation of IoT has added a new way for smart cities, smart environment, smart water system etc and has overwhelming applications in logistics, security & emergencies.

One such smart application is the IOT based Smart parking System which is implemented in the city of Santander, which is divided into 22 zones each and having its own network parameter resulting in independent sensor networks. Around 375 Waspmotes equipped with magnetic field sensors which are deployed in different locations which detects the change of magnetic field generated by car which is parked on it. This information is send periodically to the meshlium router and is displayed on panels every after 5 min to help citizens to find free parking space.

Nevertheless, failure of any one of the component of this system will lead to degrade in its performance as it will no longer deliver consistent service with its specification and would require human intervention to resolve it.

This paper establishes a proposition of Cloud and the Internet of Things along with the utilization of the powerful Naïve Bayes [5] [6] data mining algorithm to construct a efficacious system which has the potential to impart intelligence to the things in the IoT by that making them more sensible and logically enabling them to diagnose any fault or glitch in their operational status and upon detection, giving them the capability to resolve it by making the devices completely self-reliant. Thus going a step ahead by imparting 'intelligence' to the things which can encompass almost any object ranging from day to day we used appliances like coffee machine, lights, air conditioners to fuel tank in our vehicles etc. The paper also aims at conquering the limitations of IoT in terms of storage,scalability and computational ability.

In the end it presents a prototypical IoT model which is a cloud based system where in the smart sensors embedded on the devices which continuously monitors their operational status and on detecting any glitch or failure in the device functioning and which will immediately cause our application to find an appropriate solution by applying Naive Bayes data mining algorithm on the database including similar instances of malfunctioning and there by resolving it without any human intervention.

II. MATERIAL AND METHODOLOGY

a. System Interconnection and Hardware:-

1. **Sensors Details:** The hardware used to sense the various optical or electrical status of various devices is nothing but the sensors.[7][8][9]

2. **ADC:** As we know, sensors produce their status in form of optical or electrical signals. To convert those signals into useful information, the use of Analog to Digital Converter(ADC) can work for us for converting of analog to digital signal. In fig 1, sensors are connected to the ADC0808.

3. **Microcontroller AT89C51:** It's a low-powered; high performance CMOS 8-bit micro-controller having 4K of flash programmable and erasable read only memory.[10] It is a Combination of a versatile 8-bit of CPU with Flash on a monolithic chip makes ATMEL AT89C51 a powerful micro-controller which provides a highly flexible and cost effective solution for this project.

4. **MAX-232:** Data is in the form of TTL/CMOS logic will not be directly used up by the PC, it needs to be converted in compatible form. MAX 232 IC can be used to convert these logic levels to RS 232 logic levels on which the serial communication for PC works on. MAX232 IC acts like an intermediate link between PC and the micro-controller as shown in Figure 1

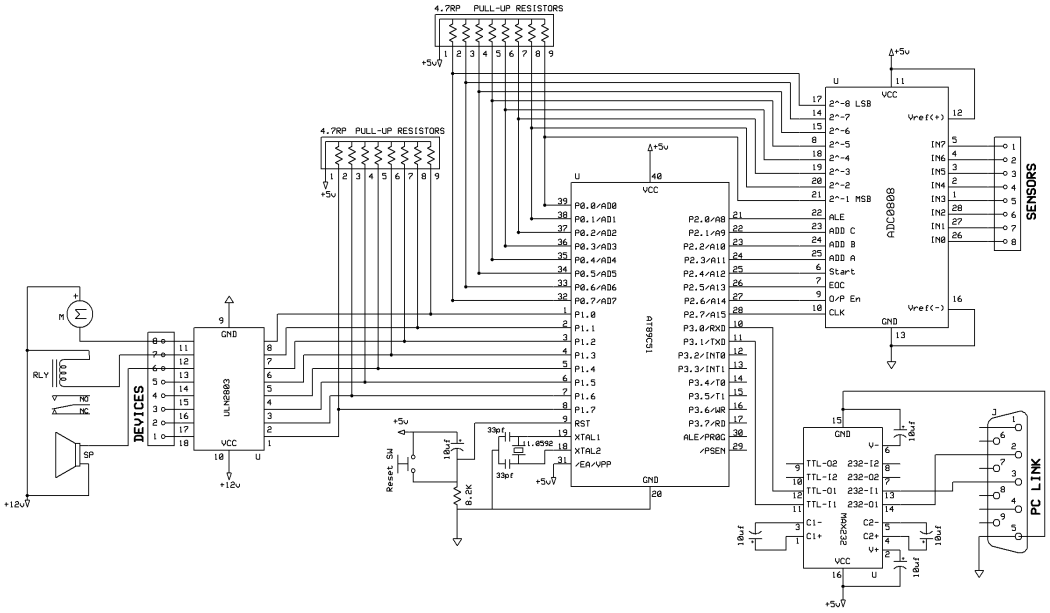

Figure 1: Proposed Circuit Diagram

b. Components of Project:-

1. The IoT Circuit

IoT circuit is a combination of micro-controllers, converters etc. which takes input from the sensors.[11] The main task of IoT circuit is to take threshold value from the sensors and send it to the home server in a digital form.[12]

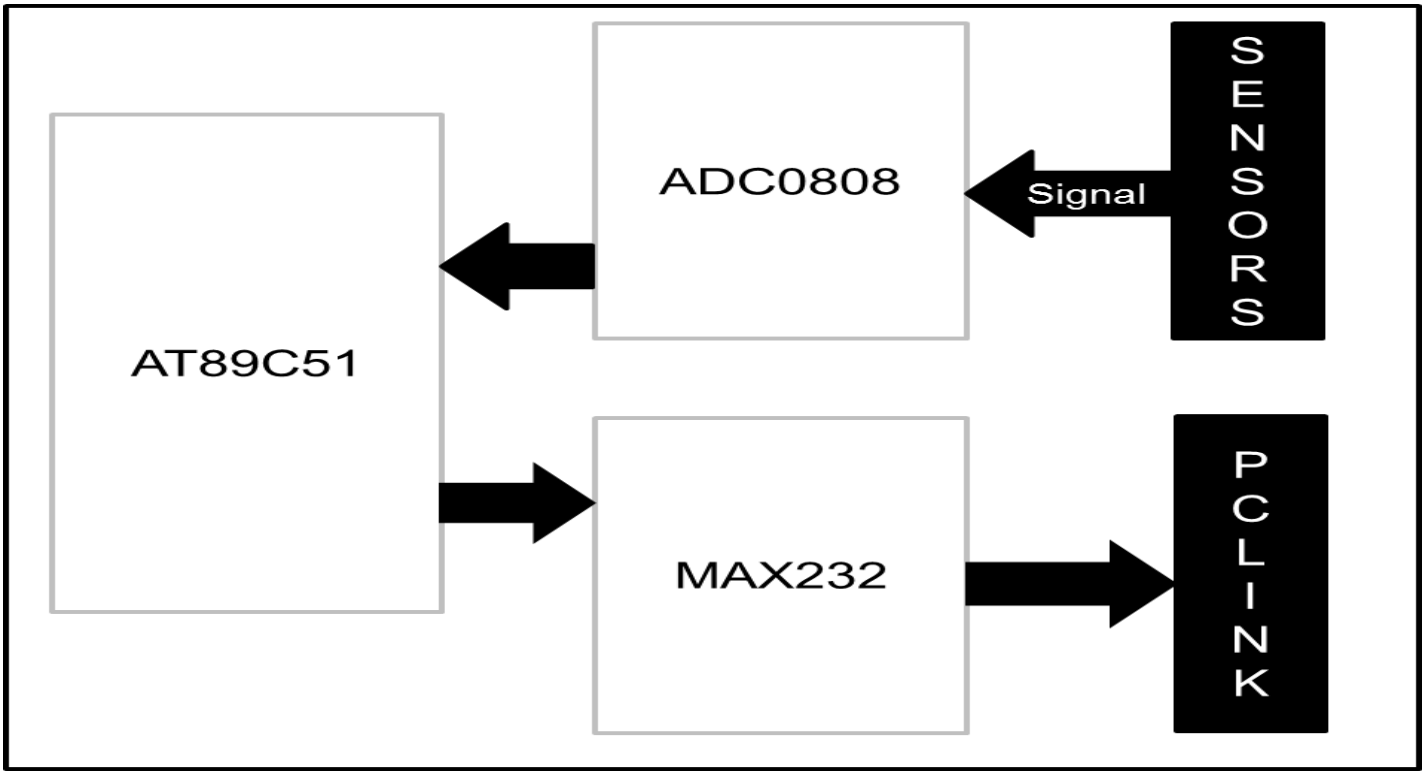

Fig. 2 IoT (Internet of Things) Circuit

2. Home Server

Home server is a server that will be installed in home. Home server takes the input from the IoT circuit and updates the data on the cloud server. It is responsible for conveying the message to the responsible person in charge as per specified by cloud server[14].

3. Cloud Server

The cloud server is the most important aspect of this project. It takes the data from the home server as input and then further processes it. The cloud server consists of a database that preserves the remedies to the problems detected during continuous inspection of the information send by the sensors. If any sensor reports a problem then, the cloud server performs data mining and picks out a particular solution that is fit to successfully decipher the complication.

This is where the Naive Bayes Algorithm comes into use, which plays an extremely important role as it is this algorithm which is responsible for imparting intelligence to the devices and making them self-sufficient.

For instance, during continuous monitoring of the light sensors, presume that some malfunctioning is diagnosed. When this malfunctioning is further corresponded to the home server it automatically applies the efficient probabilistic Naïve Bayes classifier algorithm to discover the most appropriate remedy.

Just suppose the most effective solution in our case would be an electrician with the following attributes:

- Time slot : 6pm onwards availability
- Rating : ***
- Experience : 2yrs(min)

To fulfil this task the Bayes Theorem based Naïve Bayes Classifier evaluates the probability of each attribute with the required attributes and having the maximum probability that is the one exhibiting utmost coherence is opted as the required predicted result.

Therefore, in this manner the cloud server searches for the best option in the records using data mining and retrieves the most approximate solution without any human intervention.

c. Flow Control

1. All household devices are connected to the network using specific sensors.
2. These sensors sends threshold values to the circuit
3. The ADC convert threshold values to TTL (Transistor Transistor Logic) and sends it to the micro-controller.
4. Then micro-controller sends these signals to MAX 232
5. MAX 232 converts these TTL compatible signals to system compatible.
6. The home server consists of device settings that are defined by the user. If the threshold values received from sensors which exceeds or deceeds the predefined value, then the home server considers this as a fault and send it to the cloud server.
7. The cloud server find outs the fault based on the data received.
8. Then the cloud server performs data mining to the data received from the home server to select a particular person to do the job amongst the list of several vendors.
9. The cloud server then picks the particular person in charge by applying the algorithm and sends the detail to home server.
10. The home server then receives the contact information from the cloud server and conveys the message to the person responsible.

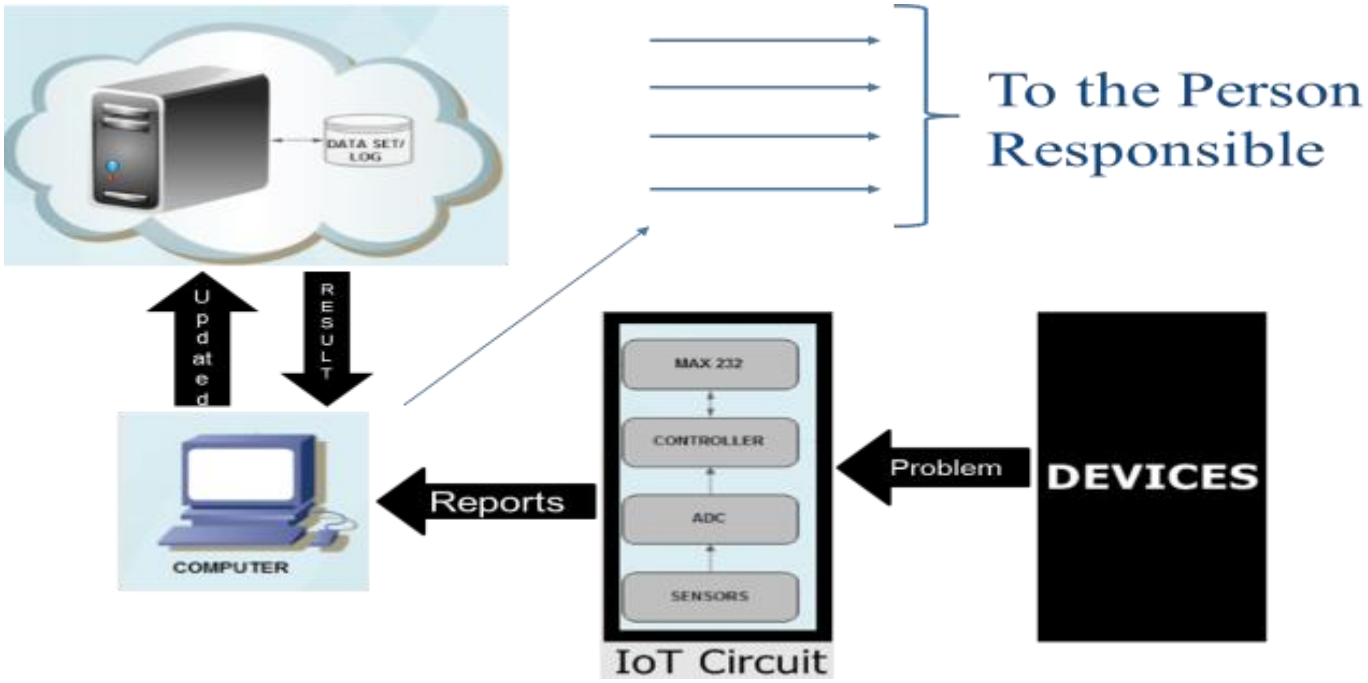

Fig. 3 Proposed Methodology (Flow Control)

III. RESULTS

These are the screenshots of project result while execution

1. Screenshot 1:

   This screenshot represents the status of the sensors initially. All the devices that are connected to the circuit are turned on. Then after a particular period of wait time these devices start working, that is it sense the environment and submit the threshold value respectively.

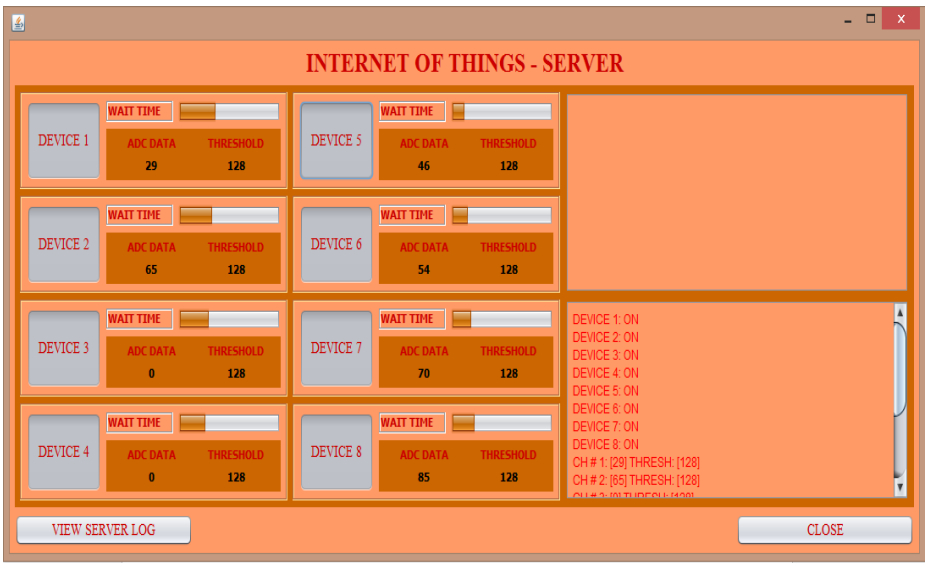

Fig. 4 Initialization of Server

2. Screenshot 2

This screenshot depicts the threshold value that is received from the sensors. These values varies from 0 to 255. User may use his own value of threshold so that he can take necessary actions.

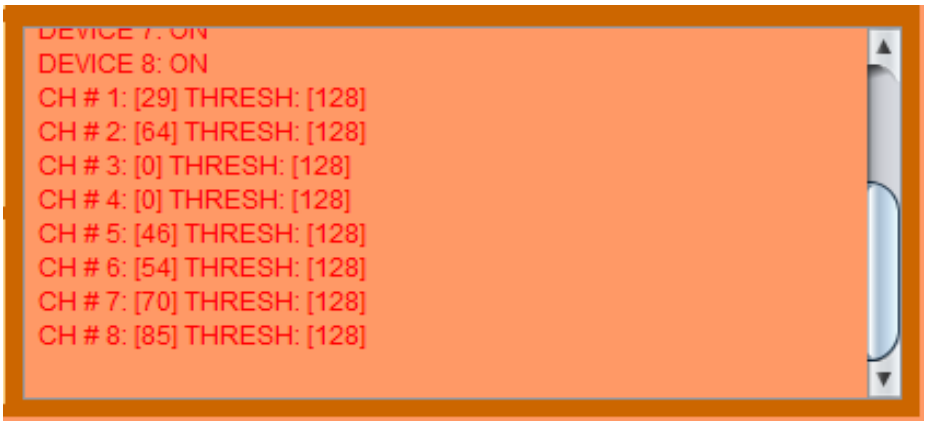

Fig. 5 Threshold Values Sent from Sensors

3. Screenshot 3:

This screenshot bring to mind the working of project. The sensors, after a particular period of wait time shows threshold values which are received from sensors. Then just as the sensor settings alerts are generated and these alerts can be seen in the upper right corner of the screen. This window shows which sensor has generate an alert and what is the threshold value crossed

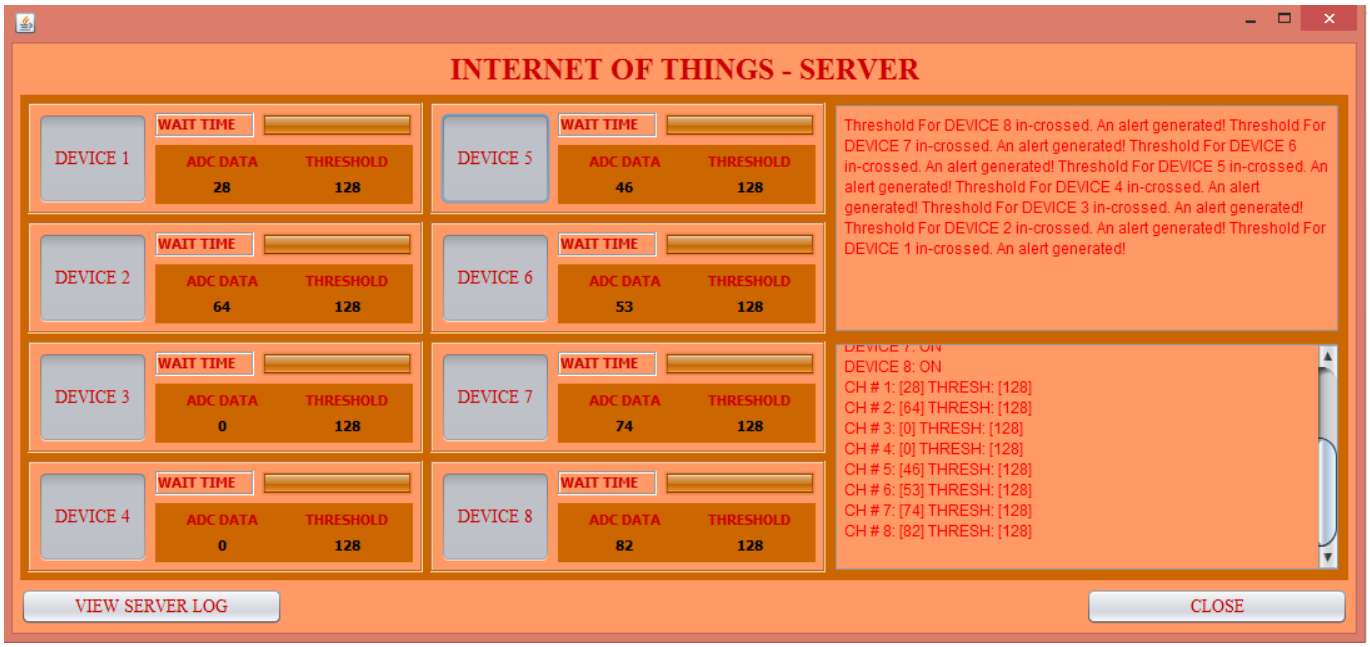

Fig. 6 Project Deployed

4. Screenshot 4:

This screenshot is of the server log which maintains a record. This record includes details about the alert generated, messages and emails that are generated for the faults and sent to the various vendors involved.

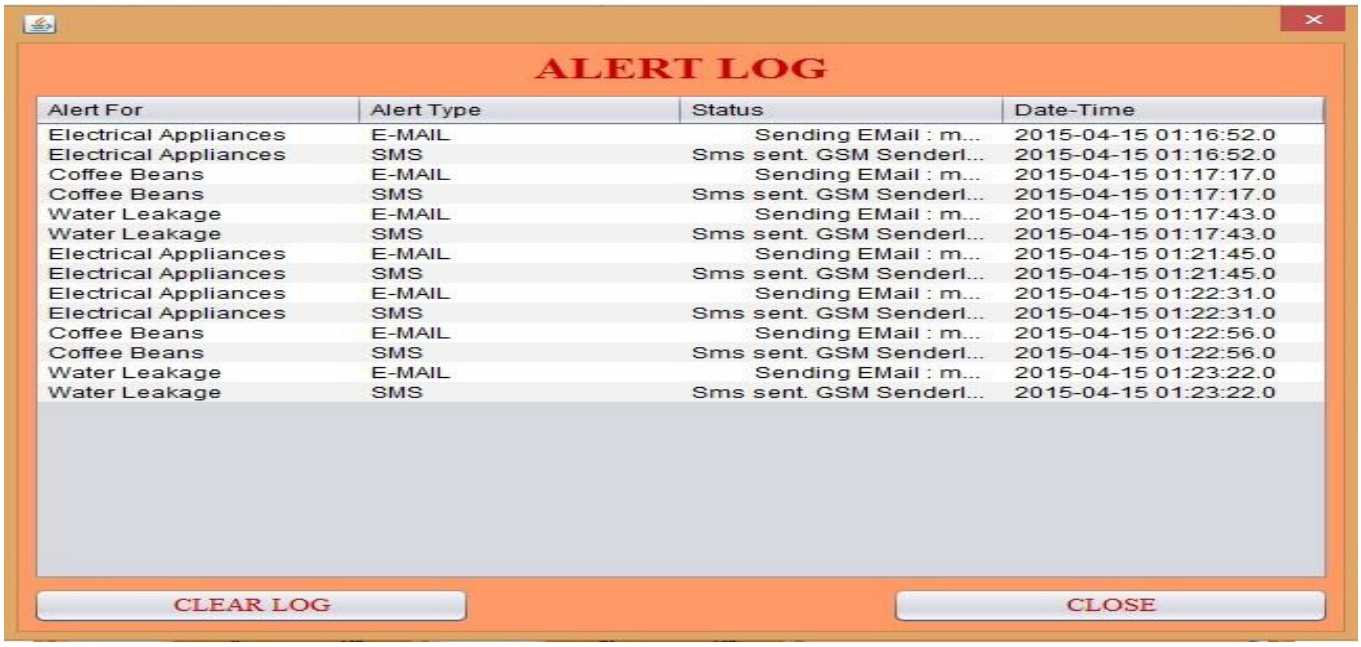

Fig.7 Fault occurrences and actions Taken

IV. CONCLUSION

This paper illustrates the implementation of Internet of Things used for monitoring regular used devices. It describes the network architecture and the interconnecting mechanisms for measurement of reliable parameters by smart sensors and transmission of data via internet. The framework described of the monitoring system is based on combination of distributed sensing units, information system for data gathering, reasoning and context awareness. This paper not only focuses on the automation but also on imparting intelligence to the things in IOT.

This paper entitled 'Evolution of IoT' which signifies Intelligent Internet of Things is aimed at providing intellectual capacity to the objects in the IOT based on cloud to enable them detect any malfunctioning in its working and rectify it without any human intervention thereby making these objects completely self-reliant.

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